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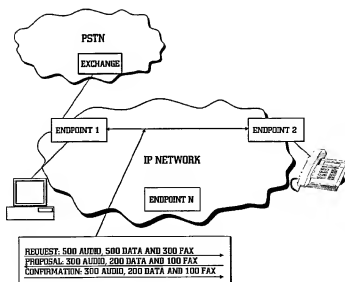
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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

- (54) Title: RESOURCE ALLOCATION IN PACKET NETWORK



- (57) Abstract: The idea of the invention is to negotiate the resource allocation between two network elements on the Application or Transport layer level so that the negotiation is possible over the network, even if the network comprises several physically different networks. To determine the transmission capacity for the allocation, the sending element must first send a request message with a proposal for the capacity and media types. The receiving element either accepts the proposal or makes a new proposal by changing the parameter values so that they are acceptable from the point of view of the receiver, and sends a response to the sending element. Based on the response from the receiving element, the sending element either accepts or rejects the allocation and informs the receiving element of its decision by sending a confirmation.

Resource Allocation in Packet Network

Field of the Invention

This invention relates to resource allocation in packet switching
5 networks, especially in IP networks.

Background of the Invention

The tasks of a network are divided into several entities, called
layers, that handle specified tasks. For example, it is possible to separate
10 four distinct layers in IP networks: the Link, Network, Transport and
Application layer (Figure 1). In known IP networks signaling handles mainly
channel related matters, such as connection set up and connection break off,
while management handles element configuration, monitoring, and error
messages, for example.

15 The Network layer is the heart of the IP network. It specifies the
format of the Internet packets, called datagrams. Datagrams contain
specified fields, such as the destination and the source of the datagram
packet. Information is sent by packets which contain the information for
routing the packet to the right destination element. The routers in the network
20 must know how to route the packets to the right receiver, so the IP layer also
includes a set of rules defining how the packets should be processed.

The Transport layer specifies means for identifying the ultimate
destination, i.e. the application in the receiving network element. The two
most common ways to handle the transport of a packet are UDP (User
25 Datagram Protocol) and TCP (Transmission Control Protocol). UDP is an
unreliable connectionless delivery system, while TCP provides reliable
delivery. That means that the TCP sender and receiver must agree that a
connection is desired. TCP requires an acknowledgment message from the
receiver before the sender is allowed to send more packets. TCP uses a
30 sliding window technique to send acknowledgments. The sliding window
indicates the number of packets that a sender can send without receiving an
acknowledgment. When the sender gets the acknowledgment concerning
the first packet sent, the window slides, making it possible to send a new
packet. The receiver can advise the sender what the preferable size for the
35 sliding window is (specifying the receiver's current buffer size). In other
words, the sliding window technique can be used for flow control.

The Application layer handles a variety of tasks, such as e-mail and file transport. This layer also contains SNMP (Simple Network Management Protocol) that handles matters such as configuration of network elements and monitoring.

- 5 The Link layer consists of a physical network, such as Ethernet and ATM. In ATM networks, for example, it is possible to group several virtual channels together into a virtual path, that is an individual manageable object.

- 10 The disadvantage of the known solutions is that there is no common way to handle the allocation of network resources in a packet network, such as an IP network. Known resource allocations are dependent on network characteristics, and thus run on the Link layer. In other words, resource allocation is possible only in the same physical network, such as ATM, but it is impossible to negotiate resource allocation between two
15 network elements in different networks using one common environment. Due to the lack of a common resource allocation method, it is complicated to agree on traffic allocation, for example between operators. Dynamic allocation can also be tedious. The objective of the invention is to eliminate these disadvantages. This is achieved in a way described in the claims.

20

Summary of the Invention

- The idea of the invention is to negotiate the resource allocation between two network elements on the Application or Transport layer level so that the negotiation is possible over the network, even if the network
25 comprises several physically different networks. To determine the transmission capacity for the allocation, the sending element must first send a request message with a proposal for the capacity and media types. The receiving element either accepts the proposal or makes a new proposal by changing the parameter values so that they are acceptable from the point of
30 view of the receiver, and sends a response to the sending element. Based on the response from the receiving element, the sending element either accepts or rejects the allocation and informs the receiving element of its decision by sending a confirmation.

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Brief Description of the Drawings

In the following the invention is described in more detail by means of figures 2 - 7 in the attached drawings, where

- 5 Figure 1 illustrates layers of a packet switching network,
- Figure 2 illustrates a capacity allocation according to the invention,
- Figure 3 depicts a capacity allocation request according to the invention,
- Figure 4 depicts a response for the capacity allocation request according to the invention,
- 10 Figure 5 depicts a pending message according to the invention,
- Figure 6 depicts a release of the resource allocation according to the invention.
- Figure 7 illustrates a time-out for a request.

15 Detailed Description of the Invention

A communication network consists of many different elements, such as exchanges and switches in traditional PSTN networks, base stations and mobile switching centers in mobile networks, and bridges and routers in datacommunication networks. Networks also contain data and signaling channels between the different elements. A packet switching IP network is more like a virtual network, which is built over several physical networks.

- Resource allocation involves a transmission capacity agreement between two network elements. The transmission capacity agreement can contain, for example, the number of channels to be used, the type of the channels (audio, data, fax, etc.) and the bandwidth of the channels.
- 25 Generally, existing technology does not include a way to negotiate resource allocation between different network elements over a variety of different networks. In order that resource allocation is possible in a packet network, there must be a common way to negotiate allocations.

- 30 Figure 2 depicts an example of a packet switching virtual network (IP network). The virtual network can contain many subnetworks, but because the virtual network forms a common way for transmission, it is reasonable to picture the network as one entity. The virtual network can have connections to other networks, such as PSTN. In this context, it is also
- 35 reasonable to name the network elements in a uniform way. Let's call the elements endpoints. In real physical networks endpoints are exchanges, routers, switching centers, etc.

Figure 2 shows an example of how a negotiation of the resource allocation between endpoint 1 and endpoint 2 is made according to the invention. The goal is to agree on the biggest possible traffic capacity between the endpoints. The negotiation channel between the endpoints is preferably formed by signaling channels in the IP network. The network handles routing of the signaling, and it is not a part of the invention. An endpoint is responsible for handling certain traffic capacity needs from the part of the network that is connected to the endpoint (for example a local exchange). The endpoint can also be responsible for handling by-pass traffic (for example a router). Figure 2 depicts the situation where endpoint 1 and endpoint 2 handle the traffic of their respective subnetworks. The negotiation between endpoints 1 and 2 starts when endpoint 1 sends a request for capacity needs. The request contains the number of different channel types required, for example 500 audio channels, 500 data channels and 300 fax channels. Endpoint 2 receives the request and compares it to its own resources. If endpoint 2 has enough capacity to handle the amount requested, it accepts the request and sends back a proposal with the same capacity values. If endpoint 2 does not accept the request, it processes the maximum acceptable values that are still smaller than the values in the request, for example 300 audio channels, 200 data channels and 100 fax channels, and sends the proposal with new values back to endpoint 1. Endpoint 1 receives the proposal, makes a decision on the acceptability of the resource allocation, and sends a confirmation comprising the decision to endpoint 2.

The function of the negotiation process according to the invention can be divided into two mandatory portions: Initial Negotiation and Renegotiation, and two optional portions: Pending Option and Removing Option.

The Initial Negotiation includes the request, the response, and the confirmation as described above. The format of the request is depicted in Figure 3. The request, like the other messages according to the invention as well, is sent over TCP or UDP, i.e. in the data field of these protocols. Version (4 bits) is a model version of the format. Version makes an adaptation possible between different updated model versions. Message (8 bits) identifies the message and allows fast interpretation of the message content. Length (2 octets) tells the length of the message in octets.

- Reservation (4 bits) is reserved for future use. Initial Token (4 octets) identifies the sender who has initialized the request. Initial Ticket (4 octets) is a parameter that is set by the sender. The receiver records the value of the Initial Ticket. The meaning of the Initial Ticket is to identify the negotiation.
- 5 Media Type identifies the desired media type, i.e. audio, video, fax, or data. Media Property (2 octets) tells the bandwidth needed for the media type. Tariff (1 octet) contains tariff information related to capacity reservation. Capacity (4 octets) tells the capacity reserved in units of media used (number of channels). Time for Validity is the time value indicating how long
- 10 the negotiated capacity is valid. Media Type and Capacity are mandatory fields, whereas Media Property, Tariff, and Time for Validity are optional fields.

- Response (Figure 4) contains the same fields as the request format except that Initial Token is replaced by Response Token, and there is
- 15 a new field: Second Party Ticket. The Response Token identifies the sender of the initial request. The Second Party Ticket is set by the receiver and recorded by the sender of the initial request. The Second Party Ticket identifies the capacity negotiation, and it is used for further negotiation to change the resource allocation. The Capacity remains the same as in the
- 20 Request if the receiver accepts it, otherwise the receiver uses its own values.

- The format of the confirmation is the same as the format of the response. The sender of the initial request sends the confirmation to the receiver with parameters copied from the response. If the sender does not
- 25 accept the values set by the receiver, it can refill the Capacity parameters to zero value indicating that the negotiation was unsuccessful. Later on, if needed, the sender can initialize a new negotiation.

- Re-negotiation is used when either one of the endpoints wants to change the Capacity parameters. The endpoint that starts the negotiation
- 30 must set Initial Ticket and Response Token to the same values as used in the initial negotiation, otherwise messages are silently discarded. The negotiation progresses the same way as in the initial negotiation.

- Pending is an optional feature (Figure 7) and it makes it possible to inform the initial sender of the request that the request is under process,
- 35 and Response will be returned before the indicated time-out. In other words, Pending tells the time-out for the Request. The receiver sends Pending after

receiving Request, but before sending Response. Figure 5 depicts the format of Pending. A new field is Time for Pending. It is the time value for how long the delay in responding is supposed to last. The rest of the fields are the same as described above: Version, Message, Length, Reservation, Response Token, Initial Ticket, and Second Party Ticket.

Removing is also an optional feature, and it is used when one of the endpoints wants to remove the capacity reserved between the endpoints. The format of Removing is depicted in Figure 6. There is one new parameter, Time for Release. The other parameters are familiar from the above. Time for Release is the time-out value that is needed before the resources negotiated are available. The removing function consists of two messages: Release and Release Acknowledged. The endpoint that starts Removing sends a Release message to the other endpoint. The Initial Ticket and Response Ticket fields in the release message are in the same values as in the initial negotiation, otherwise the message is discarded. The other endpoint sends back a Release Acknowledged message which does not include Time for Release information.

Table 1 collects the different messages together. Table 2 describes the different parameters.

Table 1, Messages

Message Identifier	Message	Description
0x1	Request	Initial request for Capacity
0x2	Response	Acknowledgment for initial request
0x3	Confirm	Final confirmation of the Request
0x4	Pending	Indicates that the Request is being processed and the handling of the Request may takes longer than usual.
0x5	Release	Releases reservation of capacity immediately or delayed, according of the Time for Validity parameter
0x6	Release Ack.	Confirms the Release operation proposed by other endpoint.

Parameter	Description
Version (4 bits)	Protocol version tells the updated version of the protocol.
Message (8 octet)	Message identifier identifies type of message.
Length (2 octets)	Tells Length of Message in octets starting from header.
Reserved (4 bits)	A field reserved for future use.
Initial Token (4 octets)	Identifies origin of the party which has initialized request
ResponseToken (4 octets)	Identifies origin of the party which has initialized response
Initial Ticket (4 octets)	Identifies capacity negotiation request and is used with further negotiations in later if original values are changed.
2 nd Party Ticket (4 octets)	Identifies capacity negotiation for 2 nd party it is used with further negotiations by initiated 2 nd party if original values are changed.
Media Type (1 octet)	Identifies the Media type. Possible values are Audio, Video, Fax or Data
Media Property (2 octets)	This field gives more detailed information of bandwidth needed for media type.
Tariff (1 octet)	The parameter tells tariff information related to the reserved media package.
Capacity (4 octets)	Parameter tells capacity reserved for Media units i.e. number of calls, ports or connections.
Time for Validity (4 octets)	The time value in seconds for how long the negotiated capacity is valid.
Time for Pending (4 octets)	The time value in seconds for how long pending is estimated to last.
Time for Release (4 octets)	The time value in seconds for how long the negotiated capacity is available.

The invention makes it possible to negotiate resource allocation between two endpoints over a network, comprised of several physically different networks. Routing is made as before in a packet switching network,

but now there is a negotiation for the resource allocation. The benefits of the negotiation are that it makes transmission more certain, makes it possible to direct transmission traffic, and especially makes one common way for handling negotiations, although there can be several different physical networks between the endpoints.

An endpoint handles transmission capacity as one pool from where it is possible to make reservations for traffic to a certain endpoint, and so the traffic load is easier to divide evenly to different directions. Resource allocations can be changed dynamically, thus an endpoint can adapt easily to different situations, such as more telephone calls in evenings, special services like telephone calls to a popular TV show, and a company's needs to transmit huge amounts of data during the day time. The invention also makes it possible to negotiate resource allocation between two operators. In this situation a SLA (Service Level Agreement) is needed between the operators.

The situation in Figure 2 where there is a negotiation for resource allocation between endpoint 1 and endpoint 2, it can be done with one negotiation for all media types. The Length field in message packets tells the total length of the negotiation message. In other words, data, audio, and fax types have their own message packets inside the negotiation message, such as a Request message. The bandwidth of a media type can be determined in the Media Property field. Consequently, the total bandwidth needed for an allocation is the bandwidth of a media type multiplied by the value of the Capacity field. The invention is especially useful when the negotiation concerns huge amount of channels.

The invention is described above at the Application layer level, but it is clear that the invention can be implemented at the Transport layer level as well. The invention can be combined with other protocols as well. For example, tunneling over H. 323, Q.BICC, and SIGTRAN are possible by embedding the resource allocation information into the payload information. Although the invention is described more like a separate protocol, it can be integrated as a portion of another protocol. It is evident that the invention is not restricted to the above-mentioned examples, but that it can be used in other implementations within the scope of the inventive idea.

Claims

1. A method for allocating transmission resources between two network elements in a packet switching network, characterized in that the resources are allocated by exchanging messages above a network layer between the two networks elements by:
- sending a request message, from the first network element to the second network element, the request message including the value of the capacity that the first element desires to allocate for use between the two network elements,
 - receiving the request message in the second network element and finding a capacity value which is acceptable from the point of view of the second network element and not greater than the value received in the request message,
 - sending a response message from the second network element to the first network element, the response message including the capacity value found in the second network element,
 - receiving the response message in the first network element and making a decision, based on the capacity value received in the response message, on the acceptability of the resource allocation, and
 - sending a confirmation message from the first network element to the second network element, the confirmation message including data indicating the decision made.
2. A method according to claim 1, characterized in that the request message further includes:
- a type of the capacity, and
 - a token for identifying the request.
3. A method according to claim 2, characterized in that the request message further includes:
- a bandwidth of the type of the capacity,
 - tariff information related to the capacity, and
 - time information indicating how long the allocation is to be valid.
4. A method according to claim 1, characterized in that the response message further includes:
- a type of the capacity to be allocated for use,

- a token for identifying the request, and
- a token for identifying the allocation session.

5 5. A method according to claim 4, characterized in that the response message further includes:

- a bandwidth of the type of the capacity,
- tariff information related to the capacity to be allocated for use, and
- time information indicating how long the allocation is to be valid.

10 6. A method according to claim 1, characterized in that the confirmation message includes:

- a type of the capacity to be allocated for use,
- the accepted capacity value,
- a token for identifying the request, and
- a token for identifying the allocation session.

15 7. A method according to claim 6, characterized in that the confirmation message further includes:

- a bandwidth of the type of the capacity,
- tariff information related to the capacity to be allocated for use, and
- time information indicating how long the allocation is valid.

20 8. A method according to claim 1, characterized in that before sending the response message, the second network element sends a pending message to the first network element, the pending message including

- 25 - a token for identifying the request,
- a token for identifying the allocation session, and
 - time information indicating the maximum time period between the request message and the response message.

30 9. A method according to claim 1, characterized in that the method further includes the steps of:

- sending a release message from one network element to the other network element for releasing the allocation,
 - sending a release-acknowledged-message from the network element that received the release message to the network element that sent the release message.
- 35

10. A method according to claim 9, characterized in that the release message includes

- a token for identifying the request,
- a token for identifying the allocation session, and
- 5 - time information for indicating how long the resource allocation is available.

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APPLICATION
TRANSPORT
NETWORK
LINK

FIG. 1

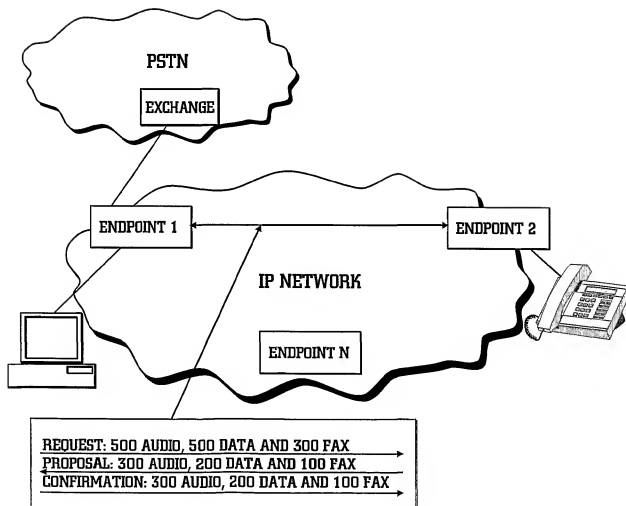


FIG. 2

2/3

0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1
VERSION		MESSAGE				LENGTH																RESERV.									
INITIAL TOKEN																															
INITIAL TICKET																															
MEDIA TYPE		MEDIA PROPERTY																TARIF													
CAPACITY																															
TIME FOR VALIDITY																															

FIG. 3

0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1			
VERSION										MESSAGE										LENGTH										RESERV.				
RESPONSE TOKEN																																		
INITIAL TICKET																																		
SECOND PARTY TICKET																																		
MEDIA TYPE										MEDIA PROPERTY															TARIF									
CAPACITY																																		
TIME FOR VALIDITY																																		

FIG. 4

0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1		
VERSION					MESSAGE										LENGTH										RESERV.								
RESPONSE TOKEN																																	
INITIAL TICKET																																	
SECOND PARTY TICKET																																	
TIME FOR PENDING																																	

FIG. 5

0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1		
VERSION					MESSAGE										LENGTH										RESERV.								
RESPONSE TOKEN																																	
INITIAL TICKET																																	
SECOND PARTY TICKET																																	
TIME FOR RELEASE																																	

FIG. 6

3/3

0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1		
VERSION		MESSAGE										LENGTH										RESERV.											
RESPONSE TOKEN																																	
INITIAL TICKET																																	
SECOND PARTY TICKET																																	
TIME FOR PENDING																																	

FIG. 5

0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1		
VERSION					MESSAGE										LENGTH										RESERV.								
RESPONSE TOKEN																																	
INITIAL TICKET																																	
SECOND PARTY TICKET																																	
TIME FOR RELEASE																																	

FIG. 6

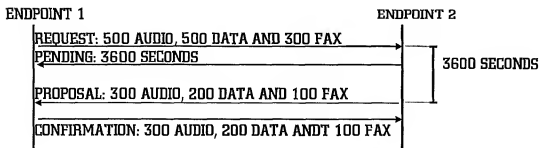


FIG. 7

INTERNATIONAL SEARCH REPORT

International application No.

PCT/FI 01/00401

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: H04L 29/06, H04L 12/56, H04Q 11/04

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: H04L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPODOC, WPI, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claims No.
X	EP 0973303 A2 (FUJITSU LTD.), 19 January 2000 (19.01.00), see the whole document --	1-10
A	US 6023606 A (PAUL A. MONTE ET AL), 8 February 2000 (08.02.00), page 12, line 13 - line 40, abstract -----	3,7

☐ Further documents are listed in the continuation of Box C.☒ See patent family annex.

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Date of the actual completion of the international search

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

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